IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicants	:	Yoshitsugu IIJIMA et al.
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For	:	PROCESS FOR PRODUCING STEEL PRODUCT AND PRODUCTION FACILITY THEREFOR
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DECLARATION UNDER 37 CFR 1.132

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S I R :

I, Yoshitsugu IIJIMA, declare as follows:

1. I am a co-inventor of the above-identified patent application.

2. My educational background is summarized as follows:

April 1987: I entered the Fourth Course of the Tokyo Institute of Technology.

April 1988: I entered the Department of Control and Systems Engineering of the Tokyo Institute of Technology.

April 1991: I graduated from the Tokyo Institute of Technology.

April 1991: I entered the Department of Mechanical and Control Engineering, Graduate School of Engineering, Tokyo Institute of Technology.

March 1993: I graduated from the Graduate School of Engineering, Tokyo Institute of Technology.

3. My work experience is summarized as follows:

a. Nippon Kokan K.K.

April 1993: I was employed by Nippon Kokan K.K.

1993 to 2003: I worked at the Instrument and Control Engineering Department, Applied Technology Research Center, wherein I was engaged in research concerning the development of control technology in a steel making process.

b. JFE R&D Corporation

April 2003 to March 2008: I worked at the Instrument and Control Engineering Department, wherein I was engaged in research pertaining to the development of control technology in a steel making process.

c. JFE Steel Corporation

April 2008 to present: I have been engaged in equipment work and systems development for a hot-rolling line.

4. The following experiments were carried out under my supervision.

The following simulation model is set forth as a comparison between applicants' claims 5, 8, 12 and 16 and Hino et al. (EP 1359230 or WO 02/050317)

The model of the calculation was performed by solving a difference formula of a heat conduction equation. The model was made wherein heating of mainly a steel product surface was performed by an induced electric current during induction heating, by the skin effect. The changes of temperature exhibited the temperature changes at the end portion of a steel plate surface, the center portion in the plate thickness direction and the average temperature.

The following were the conditions of the simulation model.

(1) Temperature when starting heating: 300°C; target temperature of heating: 650°C.

(2) Length of one unit of induction heating apparatus: 0.86 m; interval of the furnaces: 2.64 m; size of steel plate: thickness: 40 mm, width: 3,000 mm, and length: 20 m.

(3) The above-mentioned steel plate passed three times through 3 units of induction heating apparatuses. The steel plate ran backward at the second run.

(4) For every speed at the three passes, the same value was used respectively in the methods of Hino et al. and the presently claimed invention.

The enclosed Figs. B-1 to B-3 show the results for the examples of the simulation model according to Hino et al.

The method of Hino et al. concerns preventing the overheating of the steel plate surface, which is performed by initiating the heating after the steel plate surface temperature has reached the average temperature or less but, because the surface temperature of a steel plate is not considered according to the equation (1) of Hino et al., the results of the simulation model showed that the temperature exceeded the upper limit temperature (750°C and Ac_1 transformation point, in the simulation model).

In other words, Hino et al., at the time when the average surface temperature of the steel plate is decreased to the steel plate average temperature or lower, the travel speed of steel plate is determined through calculation, on the basis of the rolling pitch, by the equation (1) of Hino et al. and therefore, once a heating initiation temperature and a target temperature are determined, the electric power is obtained from the equation (1) of Hino et al.

Moreover, it is necessary every time before heating that the steel plate surface temperature is measured without fail to calculate the travel speed and the electric power. In the case of the simulation model, because of three times of passing through the induction heating apparatus, the travel speed and the electric power were calculated three times before heating.

That is to say, according to the method disclosed by Hino et al., heating is resumed when the steel plate surface temperature has reached the average temperature or less of the steel plate and according to the heating condition by Hino et al., the travel speed of the steel plate, calculated from the equation (1) of Hino et al., is determined from the rolling pitch and therefore, once a heating initiation temperature and a target temperature are determined, the electric power is obtained unambiguously from the equation (1) of Hino et al.

Nevertheless, Hino et al. do not teach or suggest a peak value of the steel plate surface temperature in the middle of heating. Hino et al. teach only preventing overheating at the steel plate surface which is performed by means of initiating heating at the time when the steel plate surface temperature has reached the average temperature or less of the steel plate.

The results for applicants' claims 5, 8, 12 and 16 are shown in the attached Figs. A-1 to A-3. In contrast to Hine et al., Figs. A1 to A-3 show that "the peak value of the surface temperature of the steel plate is always controlled, even during heat treatment so that the temperature does not exceed the maximum value of the predetermined temperature range."

Namely, according to applicants' claims 5, 8, 12 and 16, a preset value of electric power is determined by the steps as specified in applicants' claims 5, 8, 12 and 16, wherein a travel speed and the electric power at the first passing is obtained, a travel speed and the electric power are obtained every time at the second passing, third passing... and the nth passing, and therefrom, there are selected passing times which satisfy a condition that surface temperatures of the steel plate and temperatures in the center portion in the plate thickness direction, or temperatures at predetermined positions in the plate thickness direction are within the desired temperature

range, while the time of heating is the shortest or the heating is finished within a predetermined time (namely, an optimized treatment).

Therefore, according to applicants' claims 5, 8, 12 and 16, the peak value of the surface temperature of the steel plate never exceeds the upper limit temperature at all times, even in the middle of heating.

In fact, as shown in the attached Figs. A-1 to A-3, in comparison of the methods according to applicants' claims 5, 8, 12 and 16 and Hino et al., although the travel speeds of the steel plate are identical, the preset values applied to the second passing time and thereafter are different. In particular, according to applicants' claims 5, 8, 12 and 16, the values for the electric power of the third passing time and thereafter are substantially lowered, when compared with the electric power values of Hino et al.

For the reasons discussed above, applicants' claims 5, 8, 12 and 16 serve to avoid problems which arise at the time of the actual heating treatment of the steel plate, which problems cannot be overcome by Hino et al.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these

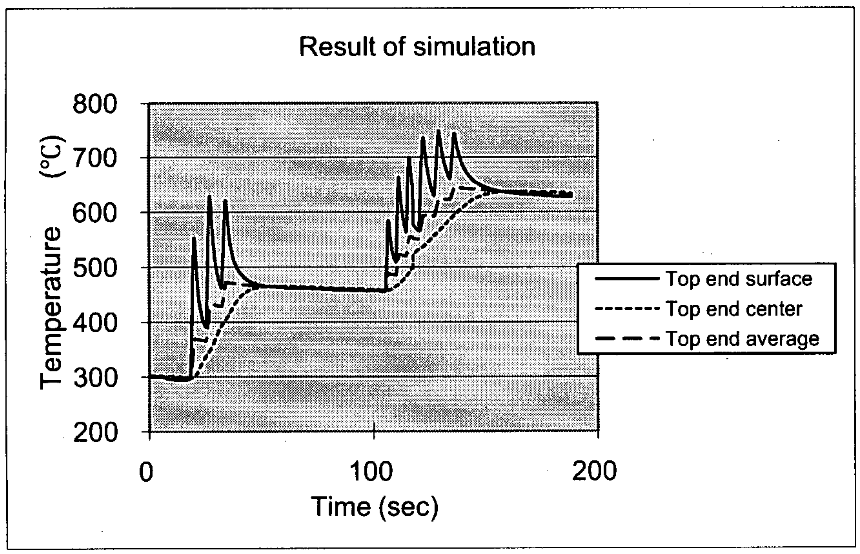
statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: November 12, 2009 By: Yoshitsugu Iijima
Yoshitsugu IIJIMA

An example, with upper limit of 750℃, wherein surface temperature exceeds the upper limit unless electric power and speed are properly selected.
(speed is same)

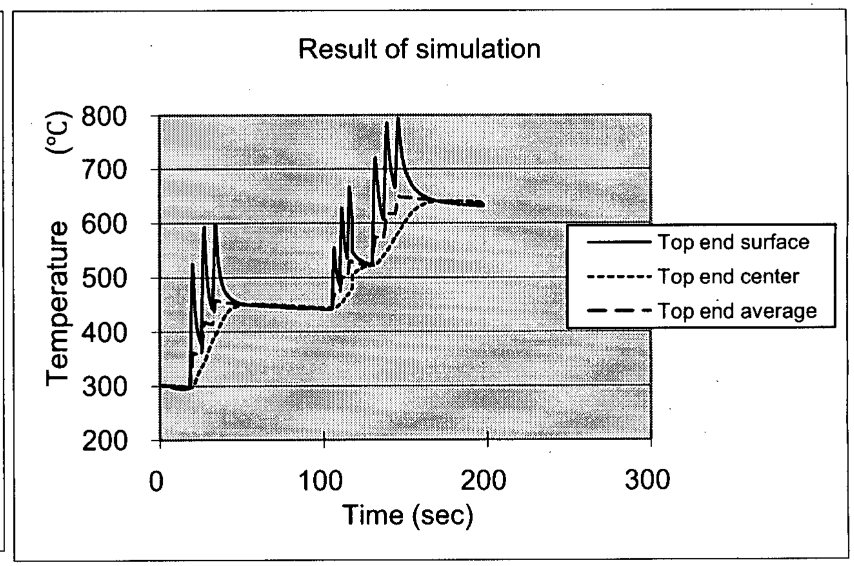
【Simulation of present application】
Calculated under upper limit of 750℃.
Stays within 750℃.

FigA-1



【Simulation of Hino】
Calculated under upper limit of 800℃.
Third heating started, after the end of second time, when surface temperture decreased to average temperature or less.

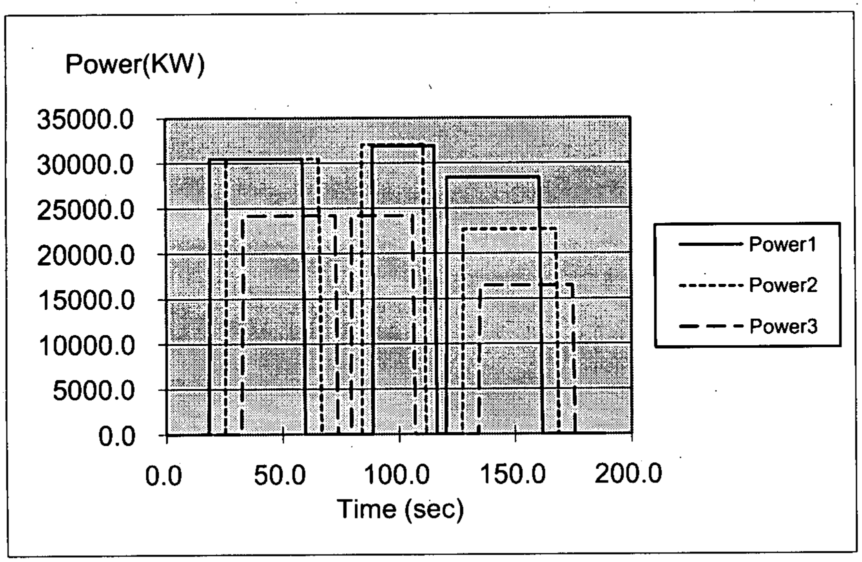
FigB-1



An example, with upper limit of 750℃, wherein surface temperature exceeds the upper limit unless electric power and speed are properly selected.
(speed is same)

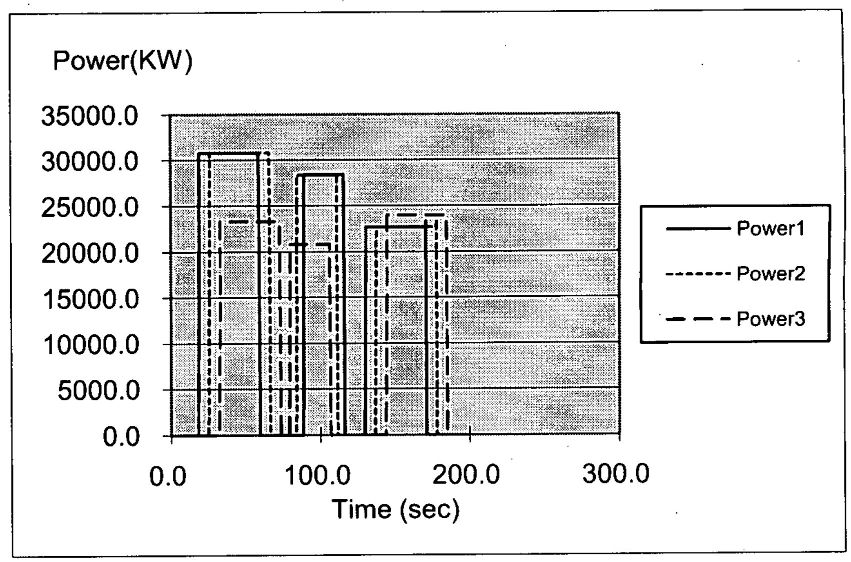
【Simulation of present application】
Calculated under upper limit of 750℃.
Stays within 750℃.

FigA-2



【Simulation of Hino】
Calculated under upper limit of 800℃.
Third heating started, after the end of second time, when surface temperture decreased to average temperature or less.

FigB-2

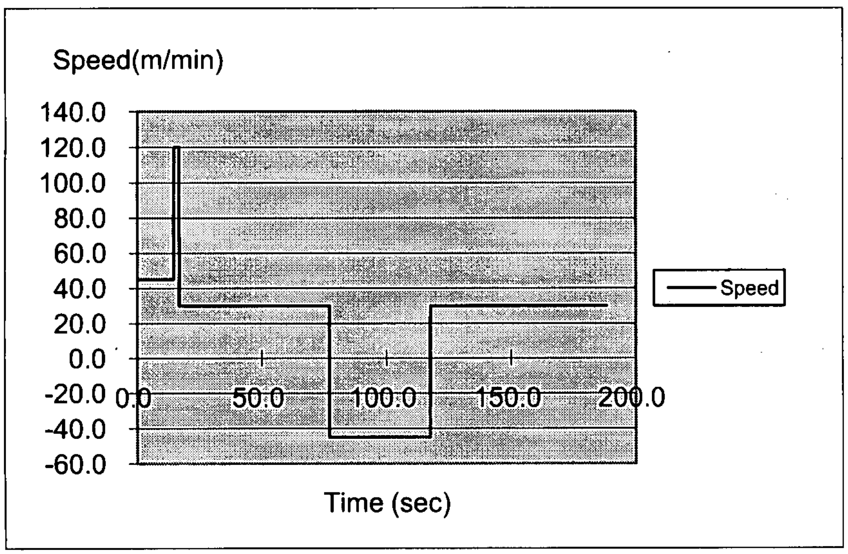


An example, with upper limit of 750°C, wherein surface temperature exceeds the upper limit unless electric power and speed are properly selected.
(speed is same)

【Simulation of present application】
Calculated under upper limit of 750°C.
Stays within 750°C.

【Simulation of Hino】
Calculated under upper limit of 800°C.
Third heating started, after the end of second time, when surface temperture decreased to average temperature or less.

FigA-3



FigB-3